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CORONAL STRUCTURES IN COOL STARS

NASA Grant NAG5-11093

Annual Report

For the period 15 July 2001 through 14 July 2002

Principal Investigator

Dr. Andrea K. Dupree

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Smithsonian Institution
Astrophysical Observatory
Cambridge, Massachusetts 02138

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| The Smithsonian Astrophysical Observatory is a member of the Harvard-Smithsonian Center for Astrophysics |
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The NASA Technical Officer for this Grant is Ronald Oliverson, Code 681.0 NASA/GSFC.

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1 Scientific Activity

Many papers have been published that further elucidate the structure of coronas in cool stars as determined from EUVE, HST, FUSE, Chandra, and XMM-Newton observations. Highlights of these are summarized in several pages following that were presented at the AAS Meeting in Albuquerque in June 2002 during the Topical Session.

2 Publications

The Capella Giants and Coronal Evolution Across the Hertzsprung Gap, O. Johnson, J. J. Drake, V. Kashyap, N. S. Brickhouse, A. K. Dupree, P. Freeman, P. R. Young & G. A. Kriss, 2002 ApJ, 565, L97

Quiescent and Flaring Coronal Structure in RS CVn Stars, J. Sanz-Forcada, N. S. Brickhouse, & A. K. Dupree 2002, ASP Conf. Ser., eds F. Favata & J. Drake, in press

Coronas in Cool Binary Stars, A. K. Dupree, (Invited) in Stellar Coronae in the Chandra and XMM-Newton Era, 2002, ASP Conf. Ser., eds. F. Favata & J. Drake, in press

Quiescent and Flaring Structure in RS CVn Stars, J. Sanz-Forcada, N. S. Brickhouse, & A. K. Dupree 2002, ApJ, 570, in press

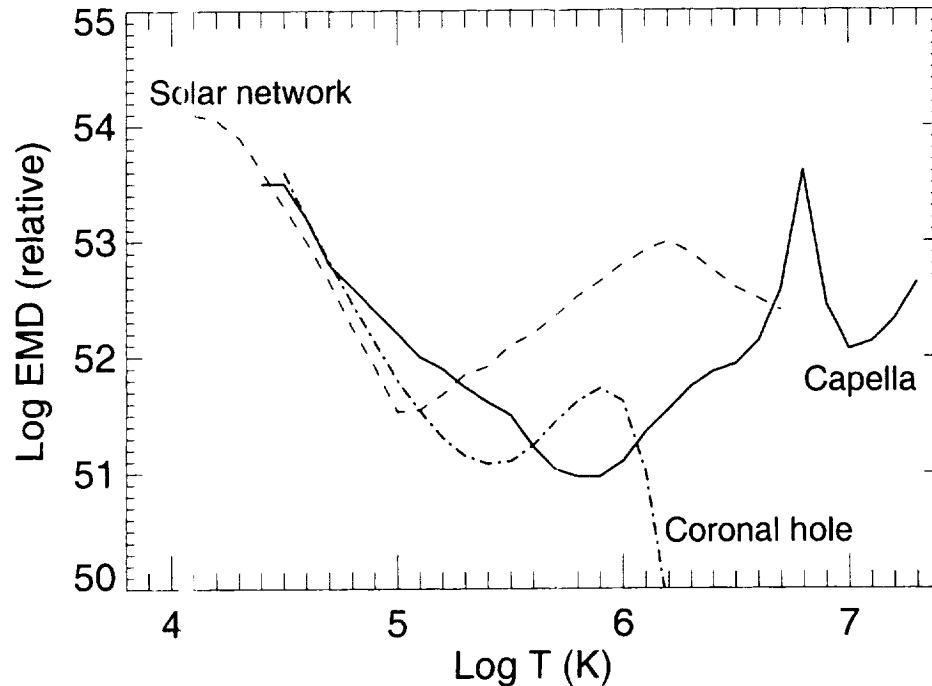
Emission Lines of Fe VII-Fe X in the Extreme Ultraviolet Region, 60-140Å, J. K. Lepson, P. Beiersdorfer, G. V. Brown, D. A. Liedahl, S. B. Utter, N. S. Brickhouse, A. K. Dupree, J. S. Kaastra, R. Mewe, & S. M. Kahn, 2002, ApJ, submitted.

The Solar-Stellar Connection: An Overview, A. K. Dupree, (Invited) in Twelfth Cambridge Workshop on Cool Stars. Stellar Systems and the Sun, ed. T. Ayres and A. Brown, 2002, in press

Coronal Structures in Cool Stars (Invited), A. K. Dupree, 2002, AAS Mtg.
200 Cool Stars and the Future (Invited), A. K. Dupree, Hubble's Science
Legacy: Future Optical-UV Astronomy from Space, University of Chicago,
April 2002

EUVE and FUSE: Coronal Connections (Invited), A. K. Dupree, 2002, in
in Continuing the Challenge of EUV Astronomy: Current Analysis and
Prospects for the Future, ed. S. Howell et al., ASP Conf. Ser. 264, 154

- **STARS: FUV/EUV/X-Ray Spectroscopy reveals surprising coronal structures.**

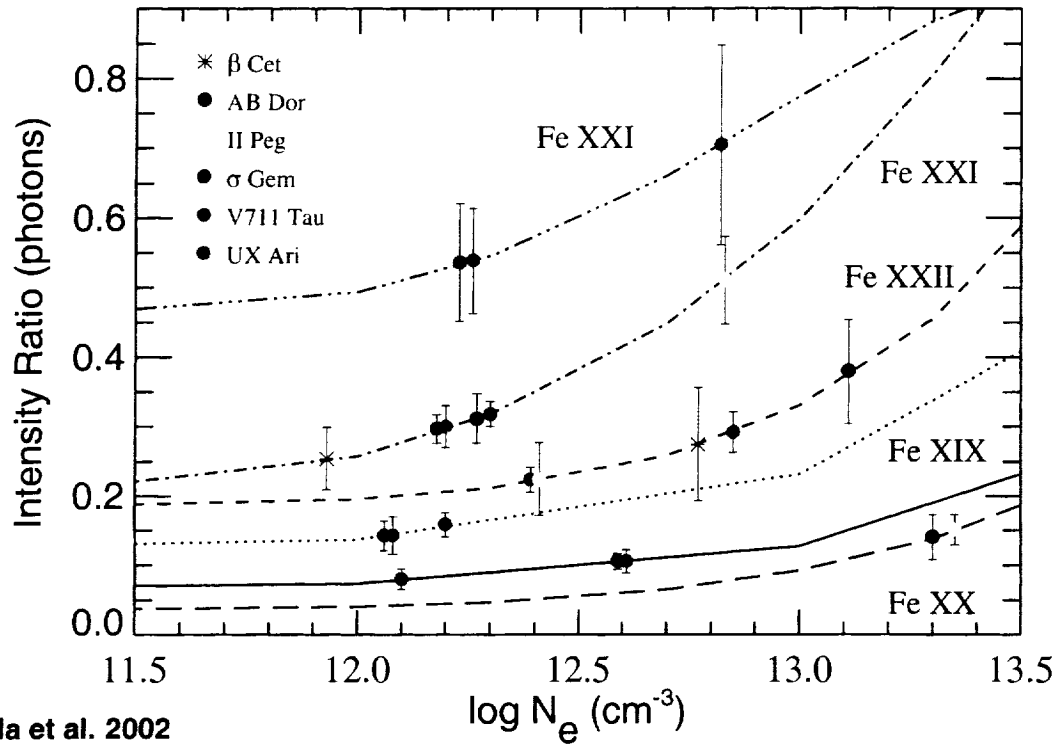


- **Continuous temperature distribution**
- **Temperature minimum $\sim 10^6$ K**
- **Stable 'Bump' feature**
 - Present in binaries and single stars
 - Enhanced during flares
 - Very small scale ($\ll R_{star}$)
 - High latitude (?)
 - Requires constant heating
- **Rotation (not binarity) determinant of structure**

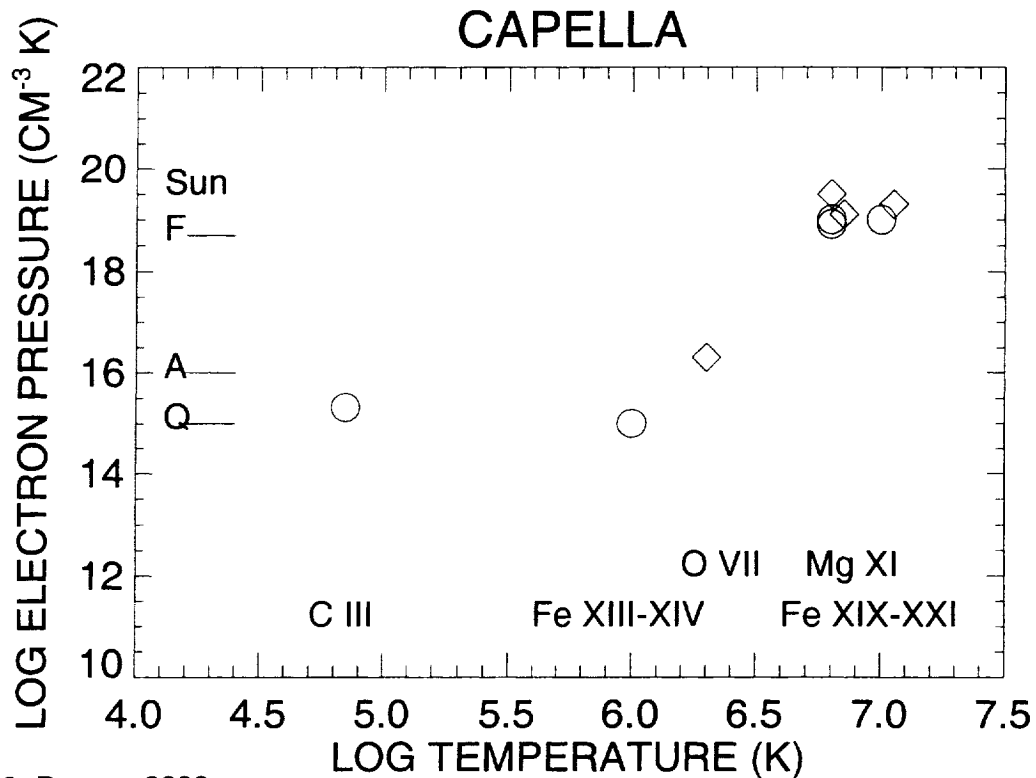
• STARS: Multiple Coronal Densities

–High: $\sim 10^{12} \text{ cm}^{-3}$ $\log T = 6.8 \text{ K}$

–Moderate: $< 10^{10} \text{ cm}^{-3}$ $\log T < 6.8 \text{ K}$



Sanz-Forcada et al. 2002



Brickhouse 2003; Dupree 2003

- **Observational Requirements:**

- 1. Sharp ‘spike’ in EMD**
- 2. High densities at 10^7 K**
- 3. Small scale at 10^7 K**
- 4. Stable EMD ‘spike’**

- **Theoretical Candidates:**

- **Solar Flares: 1, 2, 3 : YES 4: NO**
(Peres et al. 2001)
- **Nanoflare Heating: 1, 3: YES 2,4: NO**
(Klimchuk & Cargill 2001)
- **Ad-hoc Combinations of Expanding Magnetic Loops:**
1, 4: YES 2, 3: NO
(Schrijver et al. 1989; Griffiths & Jordan 1998)

